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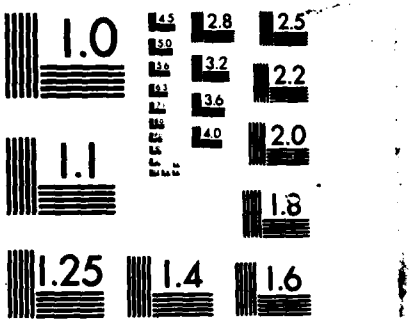

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Mossbauer
Hydrides

$TiFe_{0.8}Ni_{0.2}$ $LaNi_{4.7}Sn_{.3}$

$TiFe_{0.8}Al_{0.2}$ $TiFe_{0.8}Mn_{.2}$ $MnNi_{4.15}Fe_{0.85}$

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

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This study has been conducted to investigate the effect hydriding has on the electronic and magnetic properties of intermetallic hydrides using the Mossbauer Effect. Experiments were conducted using the 14.4 Kev Mossbauer radiation from $Fe^{57}$ and Sn isotope. Measurements were made at various temperatures between 4.2°K and 298°K. Studies were made of the changes in isomer shift and linewidth upon hydriding.

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# Mossbauer Investigation of Intermetallic Hydrides

FINAL REPORT

Frederick Oliver

Windsor Morgan

12/21/85

U.S. ARMY RESEARCH OFFICE

DAA G29 83 G 0001

MORGAN STATE UNIVERSITY

## STATEMENT OF PROBLEM

This research was a study of hydrogen absorption in intermetallic hydrides. Mossbauer and X-ray diffraction measurements were used to aid in a determination of the hydrogen absorbing mechanism occurring in hydriding. Information was sought which would provide insight into the nature of bonding and interaction between the absorbed hydrogen and the various sites in the intermetallics.

We were also interested in observing what happened to Sn in intermetallic compounds when hydrided.

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## SUMMARY OF RESULTS

Research completed under auspices of grant DAAG29-83-G-0001 has been very successful. Several papers were published and numerous presentations were made at national scientific conferences.

A. The work we now review highlights some, but certainly not all, of our more important efforts. A lot of this has already been published as full papers or abstracts (Oliver et al 1,2,3,4,5,6,7)

I. Hydrogen Absorption in $LaNi_{4.9}Fe_{.1}$ (Oliver et al 1,3,4,6,7)

The magnetic properties of $LaNi_{4.9}Fe_{.1}$ and its hydride were studied using Mossbauer and magnetic susceptibility measurements. We found there was a very small interaction between the hydrogen and the iron. Our results coupled with earlier studies by the author demonstrate that the primary mechanism responsible for holding the hydrogen occurs between the hydrogen atom and the rare-earth atoms as opposed to an interaction between the hydrogen and the transition element. More details for this system are given in papers cited.

II. Studies on TiFe, $TiFe_{.8}X_{.2}$(X=Al,Ni,Mn) and Their Hydrides (To be Published)

Mossbauer studies, X-ray diffraction, magnetic susceptibility measurements and hydrogen pressure composition isotherms were made on the TiFe series of hydrogen absorbing alloys. Addition of a third element greatly affects the pressure composition isotherms. One may vary the absorption plateau according to their interest. This work will be published as soon as work on a more sophisticated computer program is completed.

III. Studies on $LaNi_{4.7}Sn_{.3}$ (Oliver et al 2,5,6,7)

Mossbauer, X-ray diffraction measurements and hydrogen pressure composition isotherms have been made on $LaNi_{4.7}Sn_{.3}$. We are the first laboratory to complete Mossbauer measurements on a hydrided tin intermetallic compound using Sn as the Mossbauer nuclide. Results obtained here coupled with those on iron substitutions indicated again that the primary interaction occurs between the hydrogen and rare-earth atoms. This compound is one of only two compounds ever found where there is a decrease observed in the guadrupole splitting upon hydriding.

IV. Studies on $MNi_{4.15}Fe_{0.85}$ (Oliver et al 6,7)

Mossbauer measurements were completed on this compound and its hydride. Low temperature measurements indicate this sample undergoes a magnetic phase transition between room and liquid nitrogen temperature. Because of the magnetic phase transition, an inordinate amount of time is necessary for good spectra to be, obtained. Additional experiments will be made as soon as a stronger source arrives.

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3. Oliver, F.W., "Mossbauer Study of $LaNi_{4.9}Fe_{.1}$ Hydride", Bulletin of The American Physical Society, Vol. 25, No.4, p. 549 (1980).

4. Oliver, F.W., "Mossbauer Studies of Intermetallic Hydrides", 54th Annual NTA Conference, Baltimore, MD. Aug. 2-7, 1982.

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6. Oliver, F.W., Morgan, W., Thompson, K., Williams, S. and Straughn,B., 56th Annual NTA Conference, Cleveland, Ohio. July 24-28, 1984.

7. Oliver, F.W., "Mossbauer Investigation of Intermetallic Hydrides", 42nd Annual BKX Conference, New Orleans, Louisiana, March 13-17, 1985.

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